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February 13, 2015

Docket Control
Arizona Corporation Commission
1200 W. Washington
Phoenix, AZ 85007

ORIGINAL

RE: Arizona Public Service Company Home Energy Information (HEI) Pilot Final Reports at End of Pilot
Docket No. E-01345A-10-0075

Pursuant to Decision No. 72215 dated March 3, 2011, APS is required to file:

> "...a final report on the HEI pilot program by December 31, 2012, assessing all of the gathered information and state why it believes this program should or should not be fully implemented."

Decision No. 74406 extended the deadline for the final assessment report to February 13, 2015. Additionally, Decision No. 73223 requires APS to include:

> "...information regarding bill estimation experience with prepay energy service in the results report required by the Commission in Decision No. 72214 [sic]."

Attached are the Company's HEI final end-of-pilot reports.

If you have any questions regarding this information, please contact Gregory Bernosky at (602)250-4849.

Sincerely,

Lisa Malagon

LM/sb
Attachment

cc: Brian Bozzo

ARIZONA PUBLIC SERVICE COMPANY

DEMAND SIDE MANAGEMENT RESIDENTIAL HOME ENERGY INFORMATION PILOT PROGRAM

END OF PILOT REPORT

FEBRUARY 13, 2015

aps

Table of Contents

I. Executive Summary

Arizona Public Service Company (APS or Company) submits this end-of-pilot measurement, evaluation and research (MER) report for its Demand Side Management (DSM) Residential Home Energy Information Pilot Program (HEI Pilot or Program) approved by the Commission in Decision No. 72214 (March 3, 2011).[1] The HEI Pilot was a comprehensive residential demand response (DR) program that included the deployment of in-home devices intended to provide participating residential customers with transparent information regarding their energy use and costs.

The purpose of the HEI Pilot was to test a variety of available technologies and customer response to these technologies, to provide energy information that would assist the participant in controlling home energy usage, and to provide the Company with a working understanding of the devices, strategies, and mix of home applications that could be most effectively employed in a residential setting.

The HEI Pilot originally offered five technology assessment programs: critical peak pricing with a customer control device, an in-home energy display, direct load control, smart phone in-home display, and a residential prepaid energy conservation program. As the Commission is aware, the Company discontinued the in-home energy display program in 2012. This report addresses results of and knowledge gained from the critical peak pricing, direct load control, and smart phone in-home display technologies tested within the pilot. The residential prepaid energy conservation program is discussed in a separate report filed concurrently with this report.

The HEI Pilot was effective in providing APS with an understanding of the complexity and volatility surrounding the numerous components and requirements needed to develop a successful utility-scale in-home technology program. Within the pilot, the Company was able to test both the chosen technologies themselves, as well as implementation protocols, such as the reliability and stability of communication systems and the development and availability of industry standards.

New technologies for in-home devices are emerging rapidly and have advanced significantly from those available at the beginning of the pilot in 2011. APS's learnings from the pilot clearly identified the need for further study of advanced in-home technologies that are still evolving as the preferred means of energy information and communication in the home, such as the relatively new learning thermostats, for example. Specifically in this pilot, the Company experienced significant challenges with communications protocols required to communicate with the pilot technology, price and event signals, and partipant response.

Therefore, APS has terminated the HEI Pilot effective as of October 2014, and the Company does not recommend moving forward with this Program in its current form. APS will continue to monitor available technologies, test and implement advanced communications protocols, and evaluate emerging residential demand response programs for development and deployment at a future date.

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[1] APS was granted an extension of time to implement the HEI Pilot in Decision No. 73089 (April 4, 2012) and an additional extension of time in Decision No. 74406 (March 19, 2014).

II. HEI Pilot Description and Background

The APS Home Energy Information Pilot was designed to test available home area network (HAN) technologies and determine communication devices, demand response (DR) strategies, and a mix of "smart" home applications that could be most effectively employed in a residential setting. In addition, the HEI Pilot assessed customer acceptance, value, and frequency of usage of in-home energy displays or other communication devices designed to assist customers in managing their daily energy usage.

The HEI Pilot's original implementation period included the two summer seasons of 2011 and 2012, allowing APS time to choose technology vendors, solicit residential participants, install devices and communications systems, and determine measurement and evaluation techniques. APS was granted an extension of time to implement the HEI Pilot in Commission Decision No. 73089 (April 4, 2012) through 2013. APS filed a status report with the Commission on the HEI Pilot on December 31, 2012.

In APS's 2013 Implementation Plan, the Company requested the HEI Pilot be extended for an additional year, through the end of 2014. The extension was requested to allow for two full successive summers as part of its MER process in order to properly evaluate the persistence and validity of the individual technology assessments, as well as associated customer behavior patterns.

APS originally planned to deploy the following technology assessment programs as part of the HEI Pilot:

- Group A - Critical Peak Pricing (CPP) with Customer Control Device
- Group B - In-Home Energy Information Display
- Group C - Direct Load Control (DLC) with enabling technology
- Group D - "Smart" Communication Devices
- Group E – Residential Prepaid Energy Conservation Program

Of these five technology assessment programs, Groups A, C and D began implementation in 2013 and concluded in 2014. Group B was discontinued in 2012. Group E (Residential Prepaid Energy Conservation Program) was implemented in 2012 and the pilot concluded in 2014. The MER for the prepaid program is contained in a separate report which is being filed concurrently with this report.

III. Program Goals, Objectives and Participation

The HEI Pilot was developed to test available HAN technologies and determine communication devices, DR strategies, and an effective mix of home applications that can be most effectively employed in a residential setting.

The objectives of the HEI Pilot were to:

- Study advanced in-home technologies, home area network stability and communications scalability;

- Evaluate demand response and energy efficiency offerings with the use of advanced technology;
- Perform an impact study on technology for demand and conservation events, including customer participation, throughout event periods;
- Reduce peak demand and overall energy consumption through in-home technology and customer awareness; and
- Provide better information and increased awareness about how to manage energy and energy costs to customers and assess customer acceptance of the technologies employed.

No specific savings targets were set for the HEI Pilot. Instead, as noted above, APS conducted the pilot primarily to determine specific technology capabilities and customer acceptance of those technologies. However, the Company was able to identify potential demand savings and other participant impacts for each of the Groups in the pilot.

As set forth in APS's Experimental Service Schedule 16, pilot participation was approved for up to 300 voluntary participants per Program option. APS set the following requirements for participation to ensure sufficient information to perform data analysis:

- Customer must be an active residential customer with more than one year of service;
- Customer must have an average summer bill (June-September) of at least $150.00;
- Customer must reside in a single family detached home with no more than two HVAC systems;
- Customer must be served under a time-of-use rate with no demand component (or, for Group A participants, critical peak price service);
- Customer must not participate in another Company DSM programs;
- Customer must reside in their home year round;
- Customer must own a smart device (Apple iDevice for Group D); and
- Customer must have high-speed broadband internet Wi-Fi service.

Customer interest in the HEI Pilot was high, and APS processed over a thousand applications from customers wishing to participate in the pilot. The strongest customer interest was for Group C (direct load control), while the lowest interest was for Group A (CPP with a customer control device). APS was able to successfully install approximately 700 advanced in-home devices in 370 homes throughout the duration of the HEI Pilot program.

Table 1 – HEI Pilot Program Participation and Device Count

HEI PROGRAM GROUP	PARTICIPANT COUNT	DEVICE COUNT
Group – A	12	30
Group – C	208	502
Group – D	150	161
TOTAL	**370**	**693**

IV. Program Implementation

APS selected General Electric (GE) as the HEI Pilot technology contractor to develop and deploy a demand response management system (DRMS) and HAN devices for HEI Pilot program Groups A, C, and D. GE was responsible for device procurement, installation, customer support, and system integration between the DRMS and APS's existing advanced metering infrastructure (AMI). GE provided program-level management for this pilot and established a customer call center to schedule installations and provide customer support as necessary.

APS and GE conducted extensive laboratory tests beginning in the second quarter of 2011 through the first quarter of 2012, and made a number of routine and typical modifications to the technology to support actual field deployment in the summer of 2012. From March 2012 to June 2012, APS began actual field trials with pre-pilot volunteers to demonstrate field performance prior to deployment with a larger group of customers. The pre-pilot field trial provided APS an opportunity to look closely at technology compatibility and installation, along with customer experience (including education requirements as necessary) in a real-home environment. During pre-pilot field testing, a number of deficiencies and interdependencies between GE hardware and software, APS systems, vendor support solutions, and system upgrades were revealed that had not been experienced in prior lab testing.

For example, APS expected consistent illustration of the Company's rate plans through the use of smart thermostat color light-emitting diodes (LEDs) as an indicator for each price tier in order to accurately inform the customer of the associated impact and cost of air conditioner energy usage. This did not occur. The devices were expected to produce a green LED to illustrate lower cost or off-peak time of day (Tier 1 energy indicators), an orange LED to illustrate medium to high cost or on-peak time of day (Tiers 2 and 3 energy indicators), and a red LED to illustrate highest cost or peak price time of day (Tier 4 energy indicator). The pre-pilot field trial identified limitations and non-continuous illustration of the green LED display that had not occurred in prior lab testing. This complication was only one of the technology limitations and communications constraints experienced during initial deployment.

APS and GE launched an intensive study to determine the root cause of the field difficulties experienced during pre-pilot field testing. The conclusion from those investigations revealed that, while the GE solution had worked in previous applications with other utilities and in laboratory testing prior to deployment at APS, the extent and broad diversity of APS's time-of-use (TOU) rate choices created new scenarios that exposed GE hardware and software limitations. Ultimately, it was determined that a new version (2.0) of GE's DRMS needed to be developed and deployed to address the limitations of the existing system.

Due to these enhancements, APS was not able to deploy devices and begin the pilot during the summer of 2012 as originally planned. APS therefore reqested and received approval for a one-year pilot extension for Groups A, C, and D through December 2014 to allow the Company to obtain results for two summer seasons.

APS completed the second phase of factory and lab testing in February and March of 2013, followed with another pre-pilot volunteer test period in April 2013, which showed a market improvement in the effectiveness of the GE devices. APS began its

customer recruitment process in May 2013 followed by technology installation and broader pilot deployment in July 2013.

Recruitment and installation for Groups A, C, and D of the pilot began in the spring of 2013. However, in mid-September of that year, Apple released a new software platform, Apple iOS7, a major release that featured a completely redesigned user interface for iDevices, which was the device of choice for many of the participants in Group D. The Nucleus home energy management (HEM) platform developed by GE (which provided the ability to communicate with the in-home devices) and installed in all pilot participant homes encountered significant compatibility issues with this release and, as a result, participants that upgraded their smart devices to the Apple iOS7 platform were no longer able to use their devices for pilot purposes. Furthermore, even those participants that did not upgrade to the new Apple platform experienced disruptions and communication gaps. APS therefore suspended all remaining Group D technology installations at that time and returned to GE to determine the best way to move forward with the pilot under this new software platform.

After four months of rigorous testing and validations, APS and GE agreed on an HEM upgrade to restore device functionality and compatibility with iOS7. In February 2014, APS authorized a staggered and targeted release to all iDevice participants and, eventually, to the remaining pilot participants. This upgrade process continued through March 2014. It is important to note that not all pilot participants elected to perform the upgrade, which led to continued communications challenges and stability with the technology. APS began a new wave of recruitment efforts in March 2014 and resumed deployment of devices to remaining Group D participants in April 2014.

The HEI Pilot concluded on October 1, 2014 after two full summer seasons (the summer seasons of 2013 and 2014).

V. Evaluation and Monitoring

Navigant Consulting ("Navigant") was chosen by the Company to perform the MER review and evaluation of the HEI Pilot. Navigant completed an impact analysis including a process and technologies assessment of each program group within the HEI Pilot. The evaluation approach for the process and technologies focused on customer surveys in addition to a billing analysis of energy usage data for the treatment of each technology program.

Energy Impact Estimation Method

APS provided Navigant with energy usage data for active HEI Pilot participants along with non-HEI Pilot customers for the sole purpose of developing a control group analysis in order to compare results to the participant group. Navigant determined the energy impact estimation method for each pilot group as follows:

Group A - *Critical Peak Pricing (CPP) with Customer Control Device;* participants subject to Peak Event Pricing with an enabling technology (smart thermostat(s)). Navigant conducted an estimation approach to the energy savings impact of the Group A treatment by a matching method that draws on the set of program participants and their 1:1 non-program matches, drawn from a pool of non-

participating customers also subject to the Peak Event Pricing rate. This method is a regression with matching as nonparametric preprocessing for reducing model dependence in parametric causal inference (RPPM).[2] It treats matching as a "pre-processing" stage of the analysis and assumes that monthly energy use in the post-program period can be modeled as a linear regression function involving participants and matches.

Group C - *Direct Load Control with enabling technology*; the treatment group subject to Direct Load Control (DLC) via smart thermostat set-point adjustment. Navigant estimated demand savings using a fixed effects regression applied to participants' historical interval data. This analysis did not include a control group; the embedded assumption being that customers' electricity consumption on non-event days was a sufficient control for their use (and changes in use) on event days. This is a standard approach for estimating the demand impacts of DLC programs.

Group D - *"Smart" Communication Devices*; for energy information-only, an energy efficiency program. Navigant's approach used a different strategy to produce a control group. This approach is the variance- in-adoption model (VIA) method established by Harding and Hsiaw.[3] This method uses only program participants to estimate savings, with late enrollees essentially serving as controls for early enrollees. It relies on the assumption that, controlling for the customer and the monthly fixed effects, neither energy use in month '*t*', nor energy savings '*s*' months into the program, is correlated with the timing of program entry.

Additionally, in order to determine the pilot participant experience including: comfort experience, reasons for enrollment into the pilot, conservation and energy management actions taken, participant use of technologies, and participants' satisfaction with the pilot, Navigant conducted a series of surveys as shown below:

- Post-Installation Web Survey
- Decliner/Drop-Out Telephone Survey
- Post-Event Telephone Survey
- End-of-Summer Web Survey
- End-of-Pilot Web Survey

The results of Navigant's MER study is provided in the Results section below.

VI. Results

Group A – Critical Peak Pricing (CPP) with Customer Control Device

Impact Analysis.
Navigant analyzed Group A participants in three impact categories:

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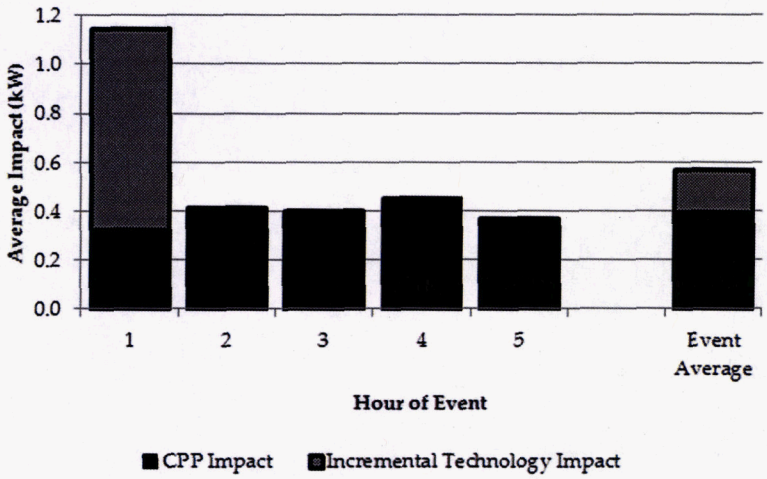
[2] Ho, Daniel E., Kosuke Imai, Gary King, and Elizabeth Stuart. 2007. Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis* 15(3): 199-236

[3] Harding, M. and A. Hsiaw. Goal Setting and Energy Conservation. July 2013. Available at: http://people.duke.edu/~mch55/resources/Harding_Goals.pdf

- DR Impacts: Estimated DR demand impacts of the Peak Event Pricing events in the summers of 2013 and 2014, the incremental DR impacts of the Group A technology, and the Group A participation rate over the period of analysis.
- Snapback Impacts: Estimated snapback impacts of the Peak Event Pricing events and the incremental snapback impacts of the Group A technology in the summers of 2013 and 2014.
- Energy Impacts: Estimated energy impacts of participation in Group A.

DR Impacts: Group A delivered approximately 0.6 kW of electricity demand reduction per participating customer across all events called by APS during the period in which Group A's technology was installed. This impact is the sum of an average impact estimated from the rate itself (Peak Event Pricing) of 0.4 kW per customer per event and an average impact of 0.2 kW per customer per event from the technology itself. The average estimated impact delivered by Group A in the first hour of the Peak Event Pricing events (between 2 p.m. and 3 p.m.) was almost 1.2 kW, of which the majority (0.8 kW) was contributed by the enabling technology.

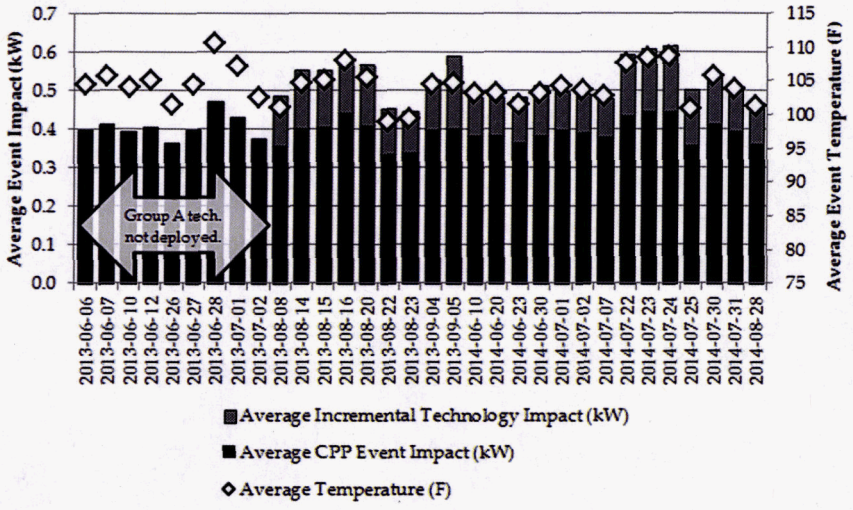
Figure 1: Group A – Average Peak Event Pricing and Enabling Technology Impacts



Source: APS interval data, GE device logs, and Navigant analysis.

No incremental technology impacts are presented for any hour but the first. Although impacts were estimated for these hours, none of them were statistically significant and so are not presented above.

Figure 2: Group A – Average Peak Event Pricing and Incremental Event Impacts

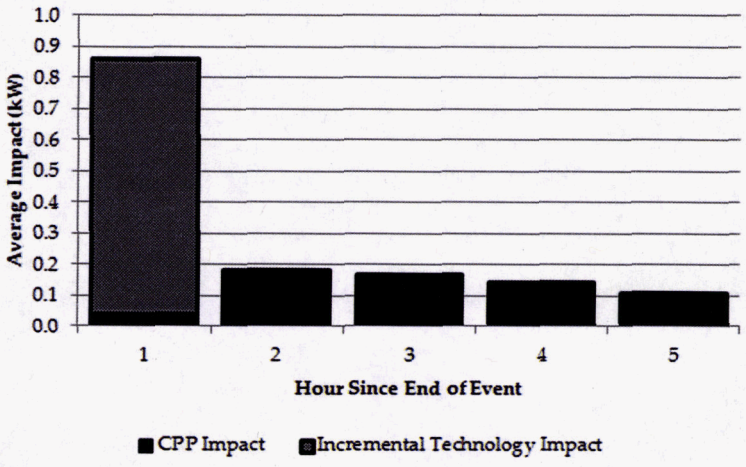


Source: APS interval data, GE device logs, and Navigant analysis.

Snapback Impacts: Snapback is a common feature of DR impacts. "Snapback" refers to the incremental additional demand in the hours immediately following a DR event that is often the result of the additional air conditioner compressor activity required to restore the given building to its set-point temperature.

Figure 3, below, shows the average snapback in each hour following the end of a Peak Event Pricing period (i.e., hour 1 in this case is the hour between 7 p.m. and 8 p.m.) that is the result of the rate alone as well as the incremental impact of the Group A enabling technology.

Figure 3: Group A – Average Hourly Peak Event Pricing and Incremental Technology Snapback Impact



Source: APS interval data, GE device logs, and Navigant analysis.

Energy Impacts: The design of the Group A program does not lend itself to energy conservation. The enabling technology permits Group A participants to respond more aggressively to a Peak Event Pricing event, resulting in greater energy demand curtailment during peak hours compared to Peak Event Pricing-only customers. This

reduction is offset by increased usage immediately following an event (snapback) when the thermostat set-point is restored to its original setting and the air conditioner compressor must work to bring down the home's temperature to this set-point. Energy savings due to the Group A technology are therefore likely to be trivial and statistically insignificant. Additionally, Navigant has estimated that participation in Group A does not deliver any energy savings that are statistically significant at any conventional level of significance.

Customer Experience and Process Assessment

Process Survey Instruments and Results. Group A participants were satisfied with all aspects of their pilot experience, and the majority found at least "some" benefits from participation. Nearly all respondents experienced some loss of comfort during DR events, with the impact of this loss felt more in 2013 than in 2014. At the end of the pilot, three-quarters of survey respondents were willing to recommend Peak Event Pricing to their friends or family and would be willing to spend at least a nominal amount to retain access to similar technology through future APS programming.

Satisfaction. In all surveys, Group A respondents expressed satisfaction with the HEI Pilot. When asked to rate their satisfaction with their pilot experience on a scale of one to ten (where one indicated "not satisfied" and ten indicated "very satisfied"), Group A respondents offered average scores of 8.3 in the Post-Installation survey; 8.0 in the Post-Event survey; 7.9 in the End-of-Summer survey; and 7.0 in the End-of-Pilot survey. This gradual decline over time is likely the novelty of the pilot that has run its course, and these customers have begun to view their Smart Thermostat as a standard technology feature of their home.

Perception of Technology. Positive perceptions of functionality declined over time. When asked if the pilot technology functioned as expected, respondents offered an initial average rating of ten out of ten in the Post-Installation survey followed by a 7.6 average rating in the End-of-Summer survey, finally ending with a 5.4 average rating in the End-of-Pilot survey.

Initially, the majority of Group A respondents claimed that they and members of their household had found the Smart Thermostat easy to use. Group A respondents rated the Smart Thermostat's ease of use as an 8.0 (on a scale of one to ten) in both the Post-Installation and Post-Event surveys, and a 7.8 out of 10 in the End-of-Summer survey. In the End-of-Pilot survey, however, the average rating declined to 5.8 on the same scale.

Group C – Direct Load Control with enabling technology

Impact Analysis.

Navigant analyzed Group C participants in the following impact categories:

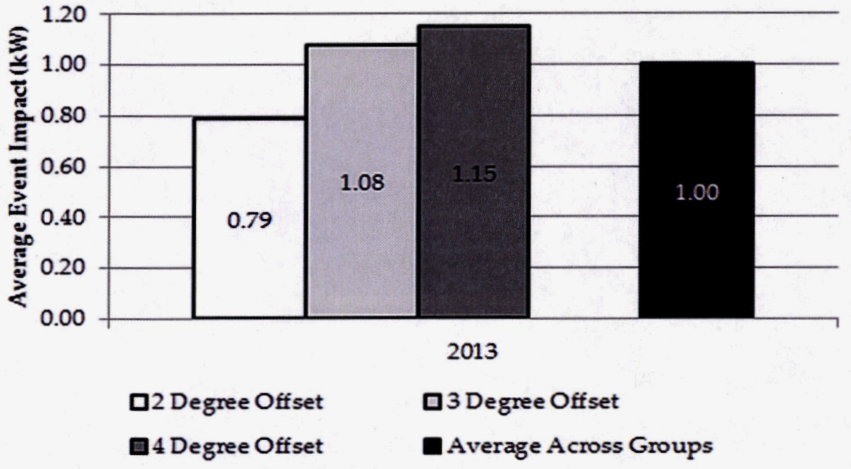
- Demand Response Impacts: Estimated DR demand impacts of the DLC events in the summers of 2013 and 2014.
- Participation: The impact of participation rate on average event impact and the observable downward trend in participation over the period of analysis.
- Event Scheduling: Describes why DR impacts are highest for a given participant in the first hour of an event and discusses APS' experimentation with "staggered" curtailment to smooth the DR profile.

- Snapback Impacts: Estimated snapback impacts of the DLC events in the summers of 2013 and 2014.

Group C is subject to a form of DLC and the DR activation begins with the increase of participants' thermostat(s) set-point by two, three, or four degrees Fahrenheit.

Demand Response Impacts: Group C participants delivered approximately 1 kW per customer of DR on average across the events called by APS. Figure 4 provides a graphic summary of average event impacts by degree offset group. (Altogether, 180 Group C participants were included in the estimation sample that delivered the estimates below. There are 55 participants in the two degree offset group, 63 in the three degree offset group and 62 in the four degree offset group.)

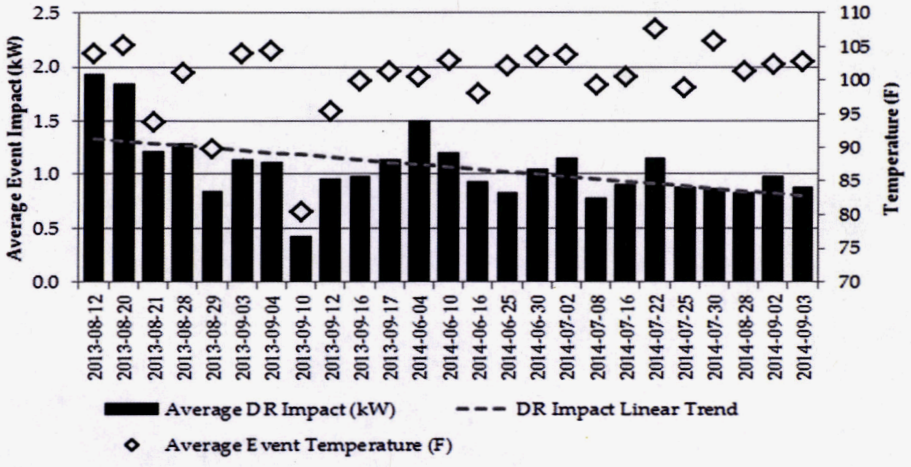
Figure 4: Group C – Average DR Impact by Degree Offset Group



Source: APS interval data, GE device logs, and Navigant analysis.

Figure 5 presents the average individual event impacts (across all offset groups). Also shown in this graphic (plotted against the right axis) is the average temperature observed across each event and an estimated linear trend in DR impacts over the length of the period of analysis.

Figure 5: Group C – Average Event Impacts



Source: APS interval data, GE device logs, and Navigant analysis.

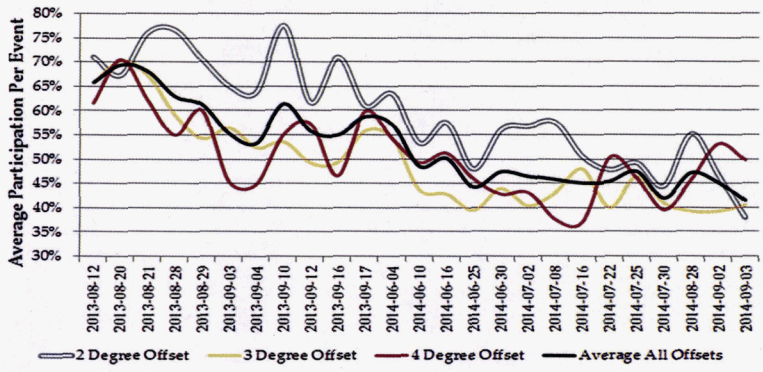
Event impacts are highly correlated with temperature. Other factors that significantly affect the average event impact include the length of the event and the level of participation.

Event length is a driver of average event impact due to the approach used for DLC in this program. This approach to DLC means that the first hour of curtailment will always have a much higher impact than subsequent hours, meaning that average event impacts will be inversely correlated with event length. Short events will have a higher average event impact.

The effect of participation on event impacts is more intuitive as lower rates of participation lead to reduced impacts. Declining participation over the period of analysis is discussed further below, but Figure illustrates the effect of that declining event participation over time on event impacts.

Participation: As noted above, the average impacts appear to have declined materially from the 2013 events to the 2014. This is, in large part, due to the declining trend in Group C event participation observed over the period of the pilot. Figure 6 illustrates participation level by offset group for each event (the partially transparent blue, red, and yellow lines) and on average across all groups for each event (the solid black line).

Figure 6: Group C – Event Participation by Event and Offset Group



Source: APS interval data, GE device logs, and Navigant analysis.

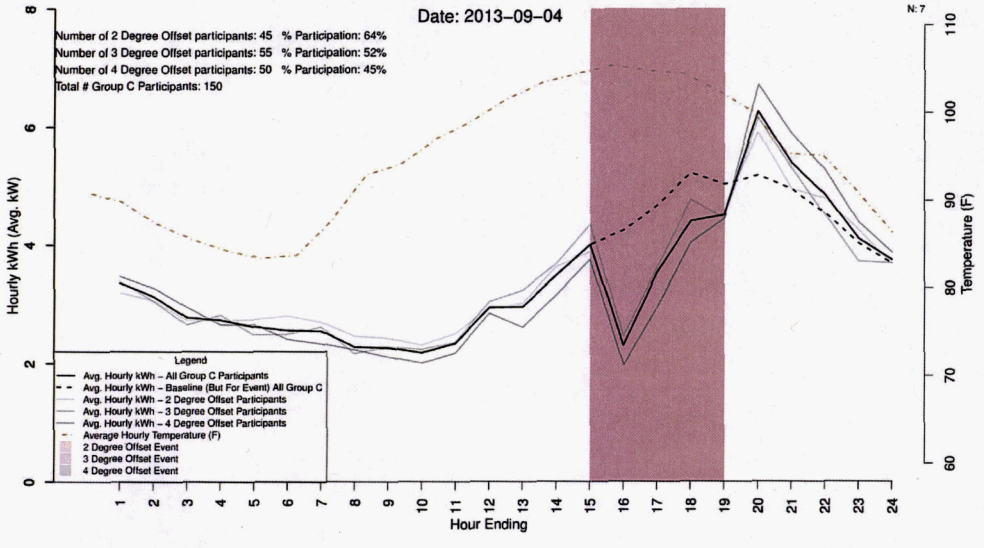
Although there is considerable variation in the level of participation from one event to the next, the overall trend is downward across the period of analysis, per Figure . There are two possible reasons for this downward trend: participant exhaustion and technical difficulties.

Navigant believes the downward-trending participation rate is the result of technical difficulties associated with the device control technology. APS controls participants' thermostat(s) remotely via a "bridge" device provided by GE. Approximately 30 to 50 percent of Group C participant devices relied, for functionality, on a connection with the given participant's Apple iOS device. A conflict between Apple devices and the firmware arose in September 2013 when Apple deployed iOS7, resulting in decreased functionality of Group C devices and translating into lower participation rates and thus lower impacts.

Event Scheduling: Event length for the average event impact is important since it relates directly to APS' decision to experiment with "staggered" events. This effect is a direct result of the approach to DLC that APS carried out in 2014 of this pilot.

Figure 7 shows the average event day load profile (on September 4, 2013) of each offset group (semi-transparent gray lines) and of the average across offset groups (solid black line). The "counterfactual" demand (i.e., what demand would have been absent the event) is represented by the dashed black line. The difference between these two lines represents the demand impact of the event. For reference, hourly temperature is shown as the dashed yellow line, to be read against the right axis. This event is described as "synchronous" because all offset groups are curtailed over the same window of time.

Figure 7: Group C – Example Event Load Profile – Synchronous Event

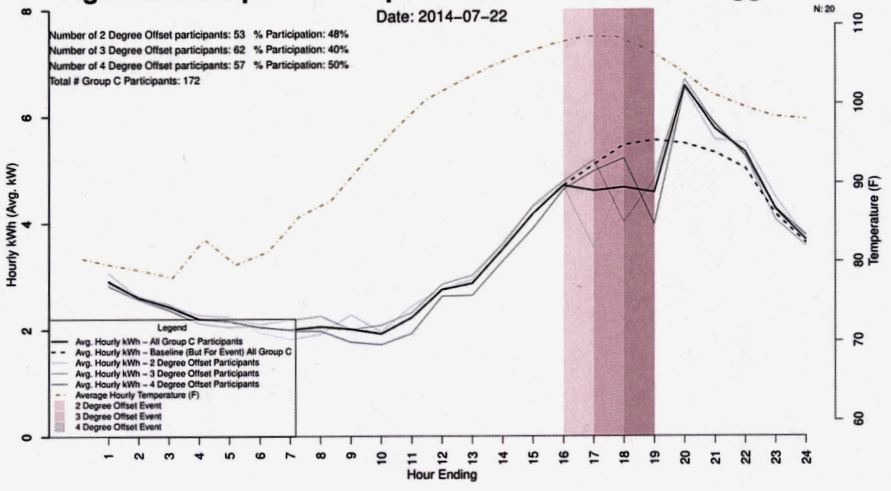


Source: APS interval data, GE device logs, and Navigant analysis.

The mechanism used to implement DLC results in a large impact in the first event hour, followed by a rapid decay to a much lower impact. The impact decays more slowly the more aggressive is the thermostat adjustment (per the difference between the darkest gray line with the lightest gray line, representing the four and two degree offset groups, respectively). Given the effect of averaging, this means that the average demand impact of a short event will inevitably be higher than the average demand impact of a longer event.

This effect also has important program design implications. System planners expecting to use DR as a resource will generally prefer a more consistent DR impact over the length of the event. However, synchronous event scheduling cannot deliver this consistency. In response to these implications, APS experimented in the summer of 2014 with "staggered" events. For these six events, the beginning of the curtailment period varied by offset group. The two degree offset group was curtailed first, followed an hour later by the three degree offset group, and then an hour after that the four degree offset group. The solid black line in Figure 8 shows this effect.

Figure 8: Group C – Example Event Load Profile - Staggered



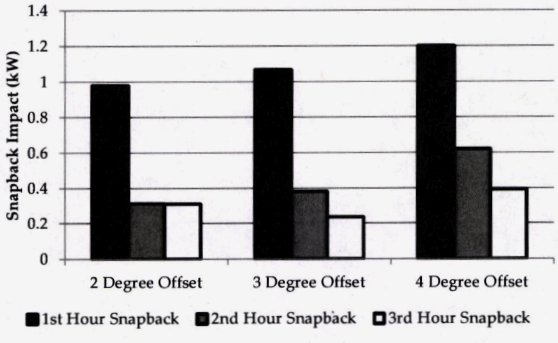
Source: APS interval data, GE device logs, and Navigant analysis.

Figure 8 shows that by staggering the offset group curtailment start times, the overall load profile may be flattened over the entire event period, delivering a more consistent DR impact, and one that tends to be positively correlated with increases in baseline demand because of the order in which the offset groups are curtailed.

Navigant believes that, should APS wish to proceed with a wider roll-out of thermostat-adjustment-type DLC programs, this experiment with staggered events has provided important intelligence to allow APS to maximize its value from such deployment.

Snapback: A well-understood characteristic of all DLC programs (whether they use thermostat control or cycling) is snapback. "Snapback" refers to the sharp increase in participant demand immediately following the end of a curtailment event as the air conditioning unit works to restore the home to its set-point temperature. Figure 9 provides the relative magnitude of average snapback impact by degree offset group.

Figure 9: Group C – Average Snapback Profile by Degree Offset Group



Source: APS interval data, GE device logs, and Navigant analysis.

Navigant estimated snapback impacts for the six hours immediately following the end of each event, but concluded, based on the statistical significance (at the 90 percent confidence level), that snapback lasts only three hours for the two and three degree offset groups, and five hours for the four degree offset group.

Snapback is the recovery of energy that would otherwise have been consumed in the first hour of the curtailment event (quite a bit since the compressor was likely not active in that hour due to the thermostat adjustment) as well as each subsequent hour (just the difference between the energy required for the compressor to provide an additional two, three, or four degrees of cooling). Each incremental hour of curtailment beyond the first, therefore contributes relatively little energy to the pool that may "snap back" following the end of an event.

This has important implications for program administrators, as participants experience minimal loss of comfort, there is relatively little cost in extending the curtailment period to later hours. One ever-present concern for DLC programs is that snapback could result in a shifting peak. This is only a concern at the system level when deployment is widespread, but even without high levels of penetration, if program participation is concentrated geographically it could be a concern at the distribution level. It is therefore important and useful to understand that extending a curtailment event in order to reduce the likelihood of shifting the peak will not result in much larger snapback.

Customer Experience and Process Assessment

Process Survey Instruments and Results. The majority of Group C participants expressed satisfaction with their pilot experience and found the technology easy to use. Regarding comfort, a majority of the respondents experienced a loss of comfort during peak events but did not identify it as a hardship. While the majority of survey respondents would recommend DLC to their friends and families, only a small minority would be willing to pay any amount to have access to this technology.

Satisfaction. In all surveys, Group C respondents reported consistently high levels of satisfaction with the HEI Pilot. In the Post-Installation survey, respondents offered an average satisfaction rating of 8.3 out of ten (where one indicated "very dissatisfied" and ten indicated "very satisfied"); an average rating of 8.0 in the Post-Event survey; an average rating of 7.6 in the End-of-Summer survey; and an average rating of 7.9 in the End-of-Pilot survey. Fluctuations in overall satisfaction from survey to survey do not necessarily reflect changes in program quality over time but instead show that participant satisfaction remained in a fairly tight range over the pilot period.

Perception of Technology. When asked to what extent the Smart Thermostat functioned as expected, Group C respondents gave an average score of 9.0 out of ten in the Post-Event survey(on a scale of one to ten, where one indicated "not as expected" and ten indicated "as expected"). This rating dropped slightly to 8.0 in the End-of-Summer survey and to 8.1 in the End-of-Pilot survey. Again, this limited decline does not seem to reflect an actual change in functionality but rather a reduction in "newness" over time.

The majority of Group C respondents viewed the Smart Thermostat as easy to use throughout the pilot period. On a scale of one to ten (where one indicated "not at all easy to use" and ten indicated "very easy to use") respondents gave the Smart Thermostat an average rating of 8.4 in the Post-Installation survey; 8.0 in the Post-Event survey; and 7.9 in the End-of-Summer and End-of-Pilot surveys. The consistency of the scores illustrates the absence of any significant difficulty in operating the Group C Smart Thermostat.

Group D – "Smart" Communication Devices

Impact Analysis.

Navigant analyzed Group D participants in the energy efficiency program through the use of smart device technology in three evaluation categories:

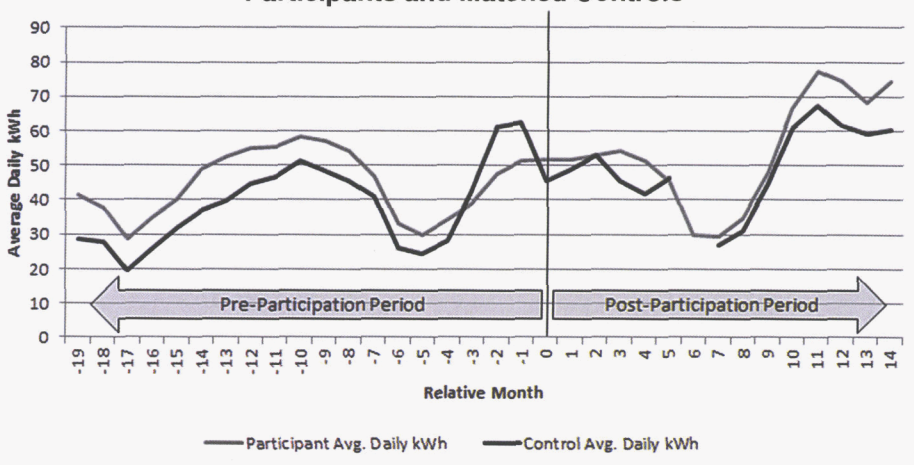
- RPPM Approach: The results of participant matching and the impact of these results on the impacts estimated using the RPPM estimation method.
- VIA Approach: The impacts estimated using the VIA method.
- Comparison of Impacts: The comparison of the impacts estimated using both approaches and provides some additional context regarding the implications of these results.

RPPM Approach: The RPPM approach relies on drawing control customers from a pool of non-participants. This approach matched a participant to a non-participant with whom that participant has the most similar pre-participation electricity consumption patterns.

For this evaluation, Navigant used a pool consisting of 555 customers. For each program participant with at least 12 months data before program enrollment, energy consumption in each month in the period was compared to that of all customers in the available control group pool with data over the same 12 months.

Figure 10 below presents the average energy use of participants and their matches over the period 't'-12 to 't'+10. The period to the left of the vertical line is the pre-participation period that was used to match the data. The period to the right of the line represents the post participation period, and it is effectively a comparison of the control and treatment group data in this period that drives the estimated impacts. Areas without a line represent periods for which no data are available.

Figure 10: Group D – Average Daily Energy (kWh) by Month – Participants and Matched Controls



Source: APS interval data and Navigant analysis.

In addition to a relatively small pool of control group customers, the data series for these customers was incomplete due to data gaps, technology stability andthe length of time that some participatants were enrolled in the pilot.

A final challenge for this analysis was the fact that due to a conflict with iOS7, the technology for this group was effectively inoperable to any participant that updated an Apple device between September 2013 (when iOS7 was deployed) and February 2014 (when a patch was deployed to restore operation). This greatly reduced the length of time in which the treatment could be observed to have had an effect on participant consumption, reducing the number of post-treatment observations and thus the likelihood of Navigant being able to estimate a statistically significant impact.

Given the handicaps identified above, in addition to relatively subtle savings effect, the results of the RPPM approach yielded no practically or statistically significant estimated demand savings.

VIA Approach:. In this case, one of the principal data limitations was the inoperability of the Group D technology that occurred between September 2013 and February 2014. Prior to the release of iOS7, approximately 50 Group D participants enrolled with the Group C technology. However, three-quarters of these participants had been enrolled for only six weeks when the technology became inoperable and none had been enrolled for more than ten weeks. This means that there is a narrow window within which the VIA approach can be applied and thus fewer data points that can be included in the analysis. This contributed to Navigant being unable to estimate practically or statistically significant impacts.

Comparison of Impacts: Neither of the two approaches undertaken by the Navigant was successful in estimating practically or statistically significant energy savings. This finding does not indicate the absence of energy savings, but simply that there were insufficient data to allow Navigant to measure them. Navigant believes that even had there been a more populous pool of non-participants from which to select matched controls it is likely that the end result may have been the same.

This conclusion is driven by the fact that the effect that the analysis is attempting to isolate is likely to be relatively modest. Most information-only energy conservation programs tend to report annual energy savings of less than four percent, and many of these make use of a much larger participant group than was available to APS in order to evaluate impacts.

Given the results of the evaluations (and because of the order in which the offset groups are curtailed), large-scale informational energy-only energy conservation programs, as well as the self-reported energy savings actions reported by Group D participants in the survey, Navigant believes that it is likely that Group D participants did realize energy savings as a result of their participation, but that the data are simply insufficient to allow those savings to be measured.

Customer Experience and Process Assessment

Process Survey Instruments and Results. The technology over time offered additional functionality, as it securely gathered energy and cost information, allowing participants to see real-time hourly, daily, monthly, and annual energy use and energy cost. This also offered participants the ability to perform usage and cost comparisons by day of the week or by month, providing further insight into their home energy management. In spite of the operating system challenges, satisfaction increased over the pilot period, but a minority of participants still had frustrations with customer service associated with the technology. Similarly, survey respondents expressed a growing regard for the functionality of the Smart App.

Participants noted during a non-summer portion of the pilot, September 2013 through February 2014, many participants had difficulties using the Smart App due to compatibility issues between GE Nucleus and their Apple iDevices (iPhones/iPads) that were on Apple's iOS7 operating system.

Satisfaction. Unlike participants in the other groups, Group D respondent satisfaction actually increased slightly over the pilot period. Post-Installation survey respondents offered an average rating of 6.1 (on a scale of one to ten, where one indicates "very dissatisfied" and ten indicates "very satisfied"), while End-of-Summer respondents rated their overall satisfaction with the pilot at 5.9 on the same scale. Given the challenges with the Group D Smart App, these moderate satisfaction scores are understandable. However, the average overall satisfaction score in the End-of-Pilot survey was 6.9.

Perception of Technology. Due to operating system issues, the Group D application did not meet the expectations of many participants. However, by the end of the pilot period, the respondents' perception of the app's functionality increased. In three surveys, when asked if the Smart App functioned as expected, Group D respondents gave the application a positive rating. Post-Installation respondents gave the Smart App an average rating of 5.6; End-of-Summer respondents gave the application 5.9; and End-of-Pilot respondents a 6.7.

In the End-of-Summer survey, Group D respondents reported that they used their pilot technology inside the home (48 percent) or both inside and outside the home (39 percent). Group D respondents also reported accessing the Smart App through a number of channels. When asked how they typically accessed their Smart App, 42 percent of respondents identified their computer; 29 percent their phone; and 19 percent their tablet/iPad. These respondents also reported using their Smart App frequently; the majority of respondents checked their Smart App either daily (45 percent) or weekly (36 percent).

Operating system issues caused a slight decline regarding ease of use but, by the end of the pilot period, this perception reversed. The majority of Post-Installation survey respondents reported that they had found the Smart App easy to use with an average rating of 8.0 (on a scale of one to ten, where one indicates "not easy at all" and ten indicates "very easy"). End-of-Summer survey respondents offered a slightly lower average rating of 7.5, but End-of-Pilot respondents offered the highest average rating of 8.3.

Regarding the usefulness of the Smart App for energy management, perceptions of effectiveness increased over time. The majority of End-of-Summer survey respondents found the Smart App somewhat helpful in managing energy use, reporting an average rating of 5.7 (on a scale of one to ten, where one indicates "not helpful" and ten indicates "very helpful"). At the end of the pilot period, Group D respondents offered a higher average rating of 6.6 on the same scale.

VII. Conclusion

The Home Energy Information Pilot provided useful information regarding various advanced in-home technologies, energy management systems and consumer energy behaviors. However, emerging technologies, communication protocols and interoperability standards have evolved at an unprecedented pace in the last several years and are expected to continue to evolve rapidly. As noted in this report, in-home device technologies existing at the time the HEI Pilot was initiated showed considerable incompatibility with APS communications networks and protocols and the consistency of program offerings proved to be difficult to maintain. For all these reasons, APS terminated the HEI Pilot in its current form in October of 2014 and does not recommend moving forward with this pilot, as previously designed.

However, APS did gain considerable knowledge through the pilot which will allow the Company to better design, implement, and deploy an in-home demand response program in the future, when feasible. In the meantime, APS will continue to monitor the industry as emerging technologies mature in the field of residential demand response programs and will continue to participate in industry forums and network with utilities and industry representatives in order to advance the development of industry standards and communications protocol for energy information and remote application devices.

ARIZONA PUBLIC SERVICE COMPANY

DEMAND SIDE MANAGEMENT
RESIDENTIAL PREPAID ENERGY
CONSERVATION PILOT PROGRAM

END OF PILOT REPORT

February 13, 2015

aps

Table of Contents

I. Executive Summary

Arizona Public Service Company ("APS" or "Company") submits this measurement, evaluation and research ("MER") report for its Demand Side Management (DSM) Residential Prepaid Energy Conservation Pilot Program ("Prepay" or "Program") as required by Arizona Corporation Commission ("ACC" or "Commission") Decision No. 72215. The Program was filed and reported on as one of the options of the Home Energy Information Pilot, which was approved in Decision No. 72214 in March 2011.

Navigant Consulting ("Navigant") reviewed and evaluated the process and impact results of the Program. The evaluation approach focused on customer surveys, conducting a pre and post billing evaluation compared to a control group to analyze the Program energy and demand savings impact, evaluating the Program's impact on customer participation in other Company DSM programs and analyzing the pattern of customer service disconnections.

The pilot provided valuable information that will be used to inform future program design and to optimize the customer experience and cost effectiveness of this program. The pilot concluded that customers used 7.5% less energy annually (or a deemed savings value of 1,235 kWh/year based on average annual usage of pilot participants), on average, after removing the impacts from disconnections and participation in other DSM programs. Customers also had high satisfaction with the program and felt they were given greater control and flexibility in their electric utility spend.

Because there are operational and scalability challenges with moving from a monthly to a daily billing system and managing the alert technology, APS recommends the program remain at approximately its current size until systems and the technologies involved evolve.

Given these findings, APS recommends that the program move from a pilot to be fully implemented as a standard DSM program and be continued at the current level of approximately 2,000 customers participating in the program. Also, due to statewide customer interest in the program, APS recommends offering this as an option to customers throughout the APS service territory.

II. Arizona Public Service Residential Prepaid Energy Conservation Program Description and Background

The Residential Prepaid Energy Conservation Program is a 'pay as you go' daily billing program that provides participants with energy efficiency and conservation information to help them better understand and manage their electric utility budget. Customers periodically prepay for electric service in lieu of paying a monthly bill after they have already consumed the energy.

Prepay was filed as one of the options in the Home Energy Information Pilot and was approved by the ACC in March 2011 in Decision No. 72214.[1]

APS launched the Prepay pilot program on July 17, 2012 to qualifying customers who had expressed an interest in Prepay. Since launch, APS filled the 2,000 customer pilot enrollment level and has maintained close to 2,000 customers.

Prior to enrolling a customer in the pilot, APS ensures that the customer adequately understands the program by reviewing the Prepay Service Agreement with the customer. Customers must clearly state consent on each item in the agreement before being enrolled. APS also provides a welcome packet to each new participant that includes the Prepay Program Guidelines, the Prepay Service Agreement, information on how the program works and tips on how to save energy with APS Prepay.

Customers have 24-hour, 7-day a week access to their account balance by calling the APS automated phone system, speaking with an associate or checking their aps.com 'My Prepay' web portal. APS provides customer account balance information by sending proactive alerts to help customers manage their account. Customers identify their preferred alert mechanism (email, phone or text message) and frequency of communication (daily or low balance). Customer contact information for alerts may be changed as often as desired at no charge.

Prepay participants can add funds to their account at any time by using any of the current APS payment options that already exist for standard billed customers. A chart included in the welcome brochure clarifies the processing fees (if any) and lag time for posting payments for each option. Payment options include APS offices, aps.com, APS automated payment system via phone, kiosks at local retailers, electronic funds transfer, authorized pay stations, and by U.S. mail.

There are no late payment, door hanger, disconnect or reconnect fees for customers participating in APS Prepay.

III. Program Goals, Objectives and Participation

The rationale for the Program is to provide customers with an opportunity to save energy as well as have more control over their energy usage and electric bill with Prepay. Based on the results of the pilot and echoed by similar results at other utility deployments across the country, the Program proved to be a vehicle for cost effective energy savings and therefore should be a program in the APS DSM portfolio.

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[1] APS was granted an extension of time to implement the HEI Pilot in Decision No. 73089 (April 4, 2012) and an additional extension of time in Decision No. 74406 (March 19, 2014).

The objectives of Prepay are to:

- Provide a convenient energy feedback and interaction system for customers;
- Provide better information and increased awareness about how to manage energy costs; and
- Reduce peak demand and overall energy consumption through customer awareness and account balance feedback.

While industry experience suggests substantial savings with prepay programs at other utilities, the pilot did not outline any specific savings targets for APS customers. Instead, APS conducted the pilot to determine savings levels from our specific technology, program design, and unique service territory to inform future Program design, implementation and deployment. Results of the APS pilot indicate that energy savings from this program can be significant with an average of 7.5% annual savings per participant. This finding is consistent with prepay deployments at other utilities which indicate that frequent energy usage feedback saves the average participating customer between 4-12% on their electric bill annually.

Per Experimental Service Schedule 16 for the Home Energy Information Pilot, Prepay participation was limited to 2,000 customers with a potential to oversubscribe participation to allow for potential dropouts during the pilot period. Enrollment in the pilot was strong and customer interest in the program was high. APS maximized customer enrollment and has maintained near 2,000 customers.

IV. Evaluation and Monitoring Activities

Navigant completed a full process and impact analysis of the program. Both will be described in detail in this report. The evaluations were based on surveys of participating customers, as well as a detailed billing analysis comparing monthly energy usage of Prepay participants (treatment group) to a matched sample of similar customers who were not on Prepay (control group). The analysis compared energy usage data for a period of time before the customer went on Prepay to energy usage data for a period of time after the customer went on Prepay for those customers in the treatment group.

The impact findings address the overall participant population as well as, where possible, specific life stage and income subcategories of participants per four types of effects:

- The *Conservation Effect* - The total reduction in energy consumption associated with average participant enrollment in the Prepay pilot
- The *Disconnection Effect* - The average reduction in energy consumption associated with the number of hours in a day a pilot participant has been disconnected from service
- The *DSM Program Effect* - The average reduction in energy consumption associated with pilot participants' enrollment in other APS demand-side management (DSM) programming. This is an absolute reduction, calculated regardless of when a given participant enrolled in a particular program.
- The *Behavioral Effect* - The net reduction in energy consumption associated with enrollment in the Prepay pilot. This effect is the conservation effect less

the disconnect effect and less the DSM program effect. The behavioral effect was also converted to a "peak demand" value representing the average load reduction between 4 and 6 p.m. on non-holiday weekdays in July and August.

Energy Savings Estimation Method

APS provided Navigant with enrollment data for 2,131 unique pilot participants. These participants enrolled in the pilot between July 2012 and October 2013. Upon initial review, Navigant removed 11 customer records because they moved from one location to another during this time period. Further review determined that pre-enrollment consumption data were available for 610 of the remaining 2,120 participants.

Navigant initially conducted a difference-in-differences analysis on the consumption data of these 610 participants. The result was an estimate of the energy impact, net of disconnections and net of DSM program influence, of a 7.9 percent reduction in annual energy consumption. While this analysis provided a point of reference for the evaluation, it did not offer insight into any of the life stage, income or seasonal subcategories. Further, standard evaluation practice is to determine savings through regression modeling.

In developing a regression model, data cleaning revealed that 86 of the 610 had sufficient pre- and post-enrollment data for adequate matching of participants to a control group of non-participating APS customers. While these 86 participants and their matched non-participating customers offered limited data, Navigant was able to develop a regression model that met evaluation practice standards and provided a credible degree of rigor.

Navigant used this regression model to estimate the conservation effect and used average kWh/Year impacts to estimate the disconnect and DSM effects. The combination of the regression results and the average impacts of disconnections and DSM participation yielded the final estimate of the behavior effect. The following section describes the methodology that Navigant used to estimate each effect individually.

V. Results

A. Energy and Demand Savings

Conservation Effect

The conservation effect is the average reduction in kWh consumption associated with participant enrollment in the Prepay pilot. Navigant analyzed a sample of 610 participants using a difference-in-differences approach and estimated a conservation effect of 7.9 percent. Using data from a representative sample of 86 participants from the larger set of 610, Navigant developed a regression model to refine the original difference-in-differences result.

The regression model yielded the results in Table 1 which lists estimates for the overall pilot population as well as for participants, as categorized by their income and life stage.

Table 1. Conservation Effect

	Point Estimate of Percent Reduction of Annual Household Energy Consumption	**90% Confidence Interval**	**Recommended Planning Estimate**
All Participants	7.6%	± 4.2%	7.6%
Low Income	24.0%	± 17.3%	
Mid Income	5.1%	± 4.7%	
High Income	9.2%	± 12.5%	
Young Life Stage	6.4%	± 5.6%	
Family Life Stage	10.0%	± 8.0%	
Mature Life Stage	5.7%	± 11.2%	
Summer	9.2%	± 6.2%	
Winter	5.6%	± 5.5%	

Source: Navigant analysis

The point estimate for the conservation effect is 7.6 percent reduction in annual consumption but, at the 90 percent confidence level, could be as high as 11.8 percent or as low as 3.4 percent. The point estimates for the life stage, income, and seasonal subcategories are not statistically distinguishable from those of "All Participants", since the confidence interval for each subcategory included the point estimate for "All Participants."

While this is still true for the Low Income subcategory, the point estimate and the confidence interval for this subcategory suggests that its conservation effect is more likely to be greater than that of the overall pilot population; however, current data are not sufficient to quantify how much greater.

Note that these estimates are statistically indistinguishable from the point estimate from the difference-in-differences approach using data from the 610 participants, but the regression methodology is more rigorous.

Disconnect Effect

Navigant estimated the average reduction in annual energy consumption due to disconnections by examining 2013 disconnection data for the 610 participants used in the savings analysis above. This required 1) estimating the share of hours that each participant was disconnected and 2) multiplying that estimate by the average annual consumption.

Not all Prepay customers were enrolled for the full year in 2013, so Navigant extrapolated the hours disconnected during the period of time that customers were

enrolled to reflect annualized hours disconnected. For example, if a customer is in the pilot for 6 months and was disconnected twice for a total of ten hours, then that customer's annualized number of disconnects would be four and their annualized hours disconnected would be twenty hours. Of the 610 customers with data available for evaluation, 18 (3%) were disconnected during their Prepay enrollment period for a total of 329 hours. After weighting to account for enrollment duration, the extrapolated annual hours of disconnection for these 18 customers amounted to 4,346 hours, or an average of 241 hours per disconnected customer per year. Given that the other 592 customers were not disconnected during their period of enrollment, the average Prepay customer was disconnected for 7.1 hours per year (4,346 hours divided by 610 participants), or 0.08 percent of the total hours in a year. Given an average pre-pilot annual energy consumption of 16,488 kWh/year and applying a 0.08 percent reduction for disconnects, the resulting reduction in energy consumption due to disconnections is 13 kWh/year per participant.

This estimate is based on disconnect frequency and duration data from early in the pilot and from only a subset of all program participants for which data were available. Descriptive statistics included later in this report on all participating customers suggest that the disconnect frequency is somewhat higher than the preliminary estimates used in this analysis. However, APS does believe that the decrease in usage from the disconnect effect is small compared to the conservation effect. Going forward, it will be important to monitor the disconnect effect over time through ongoing MER and continue to refine this estimate.

DSM Program Effect

The DSM program effect is the average reduction in kWh consumption associated with pilot participants' involvement in other DSM programs during the time of their participation. APS provided Navigant with the deemed savings associated with DSM programs for pilot participants. APS provided Navigant with 35 records of Prepay customers with participation in other DSM programs. Navigant matched 24 of these 35 records to Prepay enrollment data.

Participation in another DSM program prior to enrollment in the pilot affects pre and post- enrollment consumption equally so any savings from participating in another DSM program prior to enrollment in the Prepay pilot are not attributable to the DSM effect during pilot participation. Therefore, only savings from customers who began participation in another DSM program after enrollment in the pilot are associated with the DSM effect. Of those 24 Prepay customers who took part in another DSM program, 16 began their involvement after they enrolled in the Prepay pilot. The sum of the deemed savings from these latter 16 participants totaled 11,275 kWh/year. Extrapolated across the 2,131 participants for whom Navigant had enrollment data, the average savings per participant was 5 kWh/year. This equates to 0.03 percent of average annual energy consumption for the Prepay participants in this data set.

Behavior Effect (Conservation Effect Less Disconnect and DSM Effects)

The behavioral effect is defined as the conservation effect less the disconnect effect and the DSM program effect. The combination of these two effects, after rounding to the first decimal, is 0.1 percent. Table 2 details the behavior effect for "All

Participants" and the subcategories, calculated by subtracting this 0.1 percent from the point estimates in Table 1.

Table 2. Behavior Effect

	Point Estimate of Percent Reduction of Annual Household Energy Consumption	90% Confidence Interval	Recommended Planning Estimate
All Participants	7.5%	±4.2%	7.5%
Low Income	23.8%	±17.3%	
Mid Income	4.9%	±4.7%	
High Income	9.0%	±12.5%	
Young Life Stage	6.3%	±5.6%	
Family Life Stage	9.9%	±8.0%	
Mature Life Stage	5.6%	±11.2%	
Summer	9.0%	±6.2%	
Winter	5.4%	±5.5%	

Source: Navigant analysis

Since the behavior effect is the conservation effect minus the disconnect and DSM effects, the confidence intervals in Table 2 are the same as the confidence intervals in Table 1. As such, the behavior effect confidence intervals do not reflect any variance associated with disconnection events or DSM participation.

As discussed in the derivation of the conservation effect, Navigant recommends using the behavior effect for "All Participants" for all life stage and income subcategories because this estimate is statistically indistinguishable from the behavioral effect estimated for each subcategory.

Demand Savings

Regarding peak demand impacts, Navigant determined peak demand impacts using the average of two approaches. The first approach assumes the average per participant annual energy savings impact net of disconnects and DSM programs (i.e., 1,240 kWh) is distributed equally throughout every hour of the year, as determined by the following equation.

$$\Delta\text{kW} = \Delta\text{kWh}/8760 = 1{,}240\ \text{kWh}/8760\ \text{hours} = 0.14\ \text{kW}$$

This is consistent with approaches used to characterize demand savings for other programs and measures in APS' DSM portfolio. Navigant believes this is a conservative estimate, as savings likely vary with the participant's usage pattern, and a participant's usage is likely higher than average during the peak period due to increased cooling loads. To account for this, Navigant employed a second approach that assumes the percent savings effect is consistent through every hour of the year. Peak demand savings due to the pilot is determined by multiplying peak demand

prior to pilot participation by the behavioral effect savings percentage, as depicted in the following equation.

$$\Delta kW = kW_{peak} \times \%saved_{behavior} = 3.29\,kW * 7.5\% = .246\,kW$$

The 3.29 kW denoted as the peak demand was determined by analyzing pre-enrollment hourly interval data for pilot participants for the coincident peak period, (i.e., weekdays July-August, from 4-6 p.m.). Navigant recommends using the average of these two approaches (i.e., 0.194 kW), as it provides a balanced estimate between a lower and upper bound.

Deemed Savings

Navigant developed a deemed savings estimate for Prepay participation based on average annual participant consumption. Average pre- and post-pilot annual consumption was estimated from the sample of 86 Prepay participants for whom there was sufficient pre- and post-enrollment data for an unbiased estimate of savings. Table 3 shows that consumption declined after enrollment from 16,488 kWh/year to 15,924 kWh/year.

Table 3. Pre- and Post-Enrollment Average Annual Energy Consumption

	Average Consumption (kWh)	
	Pre-Enrollment	**Post-Enrollment**
Annual Mean Consumption	16,488	15,924

Source: Navigant analysis of APS enrollment and consumption data

While it may seem intuitive to take the arithmetical difference between the pre- and post-enrollment periods as an estimate of energy savings, this approach would not control for differences in environmental conditions between the two periods. Instead, the appropriate approach is to analyze difference in energy consumption trends, as Navigant has done, first with the difference-in-differences analysis of 610 participants and then with the regression analysis of 86 participants.

Navigant estimated the behavioral effects of Prepay by first estimating energy savings from participation, then adjusting for the effects of disconnections and DSM program participation. Based on the application of the conservation effect to the pre-pilot annual energy consumption of 16,488 kWh, Navigant calculates the conservation effect to be 1,252 kWh. After subtracting 17 kWh/year derived above to account for the disconnect and DSM effects, the behavior effect deemed savings is 1,235 kWh/year—7.5 percent of average annual consumption.

B. Costs and Cost Effectiveness

Costs Incurred

The ACC approved this pilot in Decision No. 72214 in March 2011. The costs detailed below in Table 3 are all of the costs spent designing, developing and implementing the pilot program since 2011. The capital costs indicated below were one time startup costs and are not indicative of costs for full scale deployment to our service territory in 2015 and beyond.

Table 3. – Total Prepay Pilot Costs

O&M Expenses	**2011**	**2012**	**2013**	**2014**	**Total**
Training & Tech Assistance	$0	$0	$0	$0	$0
Consumer Education	$0	$0	$0	$0	$0
Program Implementation	$60,501	$2,515	$47,649	$7,229	$117,894
Program Marketing	$0	$67,733	$6,887	$1,865	$76,485
Planning and Administration	$0	$0	$69,256	$76,311	$145,567
MER	$0	$0	$105,194	$10,001	$115,195
Cust. Participation Reward*	$0	$0	$2,147	$99	$2,246
Total	$60,501	$70,248	$231,133	$95,505	$457,387

Capital Expenses**	**2011**	**2012**	**2013**	**2014**	**Total**
Total	$956,281	$2,201,784	$537,891	$0	$3,695,956

*Pilot participants that completed at least two MER surveys were eligible for a free home energy audit ($99 value) or comparable offer.

**Only capital carrying costs are recovered through the DSMAC surcharge.

The proposed budget for 2,000 customers in 2015 is $83,500 and is broken out in the categories indicated in Table 5 below.

Table 5 - 2015 Prepay Program Budget

	2015
Training and Tech Assistance	$5,000
Consumer Education	$2,000
Program Implementation	$8,000
Program Marketing	$5,000
Planning and Administration	$63,500
Total	$83,500

Benefit Cost Analysis

Given the deemed savings results detailed above and the projected annual spend at 2,000 customers ($83,500), APS Prepay has a cost benefit ratio of 1.03. The full cost benefit analysis will be detailed in the next APS DSM portfolio filing.

C. Customer Surveys

To evaluate the customer experience in the pilot, Navigant completed a process evaluation of the pilot. The analysis included three surveys: a pre-summer survey, a post-summer survey and a drop out survey. The pre-summer and post-summer surveys were designed to measure changes in sentiment during the summer cooling season. The drop out survey was a survey of customers who enrolled in APS Prepay and subsequently disenrolled and returned to standard billing. This section provides details of all three surveys.

Dialing Statistics and Disposition Reports

In order to determine how the summer months of 2013 would affect the participant experience, Navigant conducted two waves of surveys. The first wave collected data regarding customer satisfaction, pilot involvement and household actions prior to the heat of summer. The second wave collected data on the same subjects from the post-summer perspective.

Table 6 provides the dialing statistics and disposition report for the Wave 1 participant telephone surveys that Bellomy Research conducted (under Navigant's direction) in June 2013. For Wave 1, Bellomy made 4,466 calls to complete 150 surveys. Telephone surveyors made at least one attempt for all participants and prioritized low-income and senior participants in their calling efforts. The target number of completes for this survey was originally 200, but was reduced to 150 due to lower than expected response rates. This completion target was also applied to Wave 2.

Table 6. Wave 1 Participant Survey Disposition Report

Dialing Statistic	**Total**
Sample	1717
Total Dialings	4466
Disposition Statistic	**Total**
Completes	150
Refused	302
Disconnected/Wrong Number/Blocked	433
Business/Gov't	7
Deaf/Language Barrier[2]	39
Screened Out[3]	31
Called Up to 7 Times (No Response)	755

Source: Navigant Wave 1 Participant Surveys

[2] "Language Barrier" indicates that the survey call was connected to a person but that person did not speak English or Spanish. Bellomy Research provided a Spanish-language interviewer for all respondents who preferred to answer in that language.
[3] "Screened Out" indicates that the person answering the telephone surveyor's call denied that anyone in the household were participants in the pilot.

Table 7 provides the summary sample sizes of the 150 completed telephone surveys from Wave 1. "Low-Income (E-3)" respondents are those that have an E-3 rate with APS. "Low-Income (<150% Fed. Pov.)" respondents are those whose self-reported income and household size would place them at less than 150 percent of the Federal Poverty Line. All of the "E-3" Low-Income respondents are also respondents in the "Low-Income (<150% Fed. Pov.)" sub-sample. This convention applies to all tables in this report.

In order to thoroughly describe the responses from senior citizens, this report provides their answers in two categories. The first, "Mature – Over 55 (Respondent) OR Over 65 (HH)" includes all respondents who were over 55 years of age or those respondents who reported that their household included one or more members over 65 years of age. The second, "Mature – Over 65 (Respondent) OR Over 65 (HH)" includes all respondents who were over 65 years of age or those respondents who reported that their household included one or more member over 65 years of age. All the respondents in the latter sub-sample are included in the former sub-sample. This convention also applies to all tables in this report.

Table 7. Sample Sizes for Wave 1 Respondent Groups

Total Sample	Low-Income (E-3)	Low-Income (<150% Fed. Pov.)	Mature Over 55 (Respondent) OR Over 65 (HH)	Mature Over 65 (Respondent) OR Over 65 (HH)
n	n	n	n	n
150	13	104	21	11

Note: Since "E-3" is a subset of "<150% Federal Poverty Level" and "Mature Over 55" is a subset of "Mature Over 65,"the "n's" do not sum to 150
Source: Navigant Wave 1 Participant Surveys

Table 8 provides the dialing statistics and disposition report for the Wave 2 participant telephone surveys that Bellomy conducted in September 2013. For Wave 2, Bellomy Research made 6,066 calls to complete 151 surveys. Telephone surveyors again called each participant's telephone number at least once and prioritized low-income and mature participants. Surveyors spoke with 66 re-interview respondents, who had participated in the Wave 1 round of surveys, as well as 85 respondents who had not taken part in previous survey activity related to Prepay. The sample sizes of Wave 2 respondent groups are shown in Table 9 and have the same definitions as those of Wave 1 in Table 7.

Table 8. Wave 2 Participant Survey Disposition Report

Dialing Statistic	Total
Sample	2089
Total Dialings	6066
Disposition Statistic	**Total**
Completes	151
Refused	340
Disconnected/Wrong	651

Number/Blocked	
Business/Gov't	29
Deaf/Language Barrier	4
Screened Out	72
Called Up to 7 Times (No Response)	842

Source: Navigant Wave 2 Participant Surveys

Table 9. Sample Sizes for Wave 2 Respondent Groups

Total Sample	**Low-Income (E-3)**	**Low-Income (<150% Fed. Pov.)**	**Mature Over 55 (Respondent) OR Over 65 (HH)**	**Mature Over 65 (Respondent) OR Over 65 (HH)**
n	**n**	**n**	**n**	**n**
151	8	95	16	9

Source: Navigant Wave 2 Participant Surveys

Drop-Outs

Table 10 provides the dialing statistics and disposition report for the Drop-Out telephone surveys. For the Drop-Out surveys, Navigant made 90 calls to reach 10 completes. The target number of completes for this survey was 10 due to the limited sample size.

Table 10. Drop-Out Customer Survey Disposition Report

Dialing Statistic	**Total**
Sample	68
Total Dialings	90
Disposition Statistic	**Total**
Completes	10
Partial Completes	2
Refused	3
Disconnected/Wrong Number/No Answer	19
Business/Gov't	0
Deaf/Language Barrier	2
Other	4

Called Up to 3 Times (No Response)[4]	28

Source: Navigant Drop-Out Surveys

Demographics

Wave 1 Participant Demographics

Of Wave 1 respondents, the largest segment of participants was low-income, Caucasian individuals between the ages of 25 and 44 years old. This was true across all respondent groups, although the low-income respondents showed a slightly higher percentage of Hispanic respondents. Most respondents were renters (83 percent) who had lived in their homes for less than one year (63 percent). Over 60 percent of total respondents had fewer than four people in their household, and another close to 30 percent had between four to six people. Eighty-eight percent of respondents claimed that their household had no members over 65 years of age.

The majority (68 percent) of total respondents reported a household income of less than $50,000, and of those respondents, 68 percent reportedly made less than $25,000 per year. This suggests that the program is reaching the low-income audience. However, of the 17 percent of households who earn over $50,000 per year, roughly half earned over $65,000 per year, suggesting that low-income customers are not the only households taking advantage of the program.

Wave 2 Participant Demographics

Wave 2 respondents were relatively similar to those from Wave 1 in that most were low-income individuals between 25 and 44 years old with "Caucasian" the most often identified ethnicity. Again, the low-income respondents showed slightly higher percentage of Hispanic respondents. Nearly half of the respondents had lived in their homes for less than one year, and an additional 43 percent had lived in their homes for less than five years. Over half of the respondents had fewer than four people in their household, and 40 percent had between four to six members in their household. Again, 88 percent of respondents had no household members over the age of 65, confirming that the "mature" audience did not make up a significant portion of the program's participants.

A slightly higher number of Wave 2 respondents were low-income, with about three-quarters of respondents claiming to earn less than $50,000 per year for their household. About 64 percent of those households reportedly earn less than $25,000, which was comparable to the Wave 1 findings. About 44 percent of those households earning more than $50,000 per year earned over $65,000, which was also comparable to Wave 1 responses. The consistency of these responses suggests that while low-income customers make up a major part of program participants, a number of participants are well above the poverty line.

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[4] Navigant was able to reach the target of 10 completed surveys with only three attempts to Drop-Out customers that did not respond.

Drop-Out Respondent Demographics

Of the Drop-Out respondents, about a third were Caucasian, another third were African American, and about 20 percent were Hispanic. Two respondents refused to answer. The majority of respondents (70 percent) rented their homes and half claimed that this was their primary, year-round residence. Most respondents claimed that fewer than four people lived in their household for at least half of the year, and 70 percent of respondents claimed that their household did not include anyone over the age of 65. When asked the respondents' age, 40 percent reported to be between 45 and 50 years old, while the rest of the responses varied. Similar to the participant surveys, 70 percent of respondents reported a household income of less than $50,000 per year, further confirming that low-income individuals were the most prevalent participant group in the Prepay pilot.

Summary Demographics Findings

In general, the survey responses indicate that the pilot appealed to low-income customers who rented their homes. Further, a majority of participant and Drop-Out respondents live in their current residence for less than one year. The preponderance of low-income, rental abodes and short terms of residence suggests that the pilot has attracted a market segment with high mobility. Future research could determine how this mobility affects participant satisfaction and energy savings.

Satisfaction

Throughout this section, tables include the term "Top Box" as a category for responses of eight, nine, or ten to variations on the question "on a scale of one to ten, where one indicates 'very dissatisfied' and ten indicates 'very satisfied,' how satisfied where you with . . . ?" Per this convention, the "Top Box" category indicates the highest levels of satisfaction. The tables in this section also provide a more general category of satisfaction as scores greater than five ("6-10"). Dissatisfaction is defined as scores of five or less.

Participant Overall Program Satisfaction

Both waves of respondents were very satisfied with the pilot, overall. About 71 percent of Wave 1 respondents and 78 percent of Wave 2 respondents replied with satisfaction scores of eight to ten out of ten, as shown in Table 11. There was very little change in overall satisfaction with the pilot from Wave 1 to Wave 2; average satisfaction scores from both low-income groups rose by one to two points, while scores from both mature groups dropped by one point (from nine to eight). Although the majority of mature respondents were never dissatisfied, this post-summer decline occurred in overall satisfaction, as well as for nearly every other type of satisfaction covered by the survey.

Table 11. Overall Pilot Satisfaction for Wave 1 and 2

Question	Wave 1					Wave 2				
"On a scale of 1 to 10, where 1 indicates 'very dissatisfied' and 10 indicates 'very satisfied,' how satisfied are/were you with APS Prepay so far?"	n*	Ave	Std. Dev.	Top Box	6-10	n*	Ave	Std. Dev.	Top Box	6-10
Total Sample	150	8	2.77	71%	82%	151	9	2.3	78%	89%
E-3	13	7	3.67	54%	69%	8	9	1.1	88%	100%
150% of Federal Poverty Limit	104	8	2.92	71%	80%	95	9	2.4	82%	91%
Mature: 55+	20	9	1.94	90%	90%	16	8	3.2	75%	81%
Mature: 65+	11	9	1.96	91%	91%	9	8	3.6	67%	78%

*Satisfaction values were taken only from respondents who offered a score - respondents who answered "Don't Know" or who refused to answer the question were not included

n's listed here exclude "Don't Know" or "Refused" responses
Source: Navigant Participant Surveys

When asked their reasons for enrolling in the pilot, most respondents cited financial reasons, such as the program could be used to better manage their budgets and that there was no security deposit. This was true for all respondent groups in both waves. Non-financial reasons, such as the ability to track energy usage or to save energy were rarely mentioned, with only a few percent of respondents mentioning these as their primary reasons for enrolling in the pilot. Few respondents gave any other reasons for enrolling in the pilot, indicating that financial factors were the primary drivers of pilot participation. The full list of responses can be found in Table 12 and Table 13.

Table 12. Wave 1 Reasons for Enrollment

Question					
What was the MAIN REASON you chose to enroll in APS Prepay?	**Total (n=150)**	**E-3 (n=13)**	**150% (n=104)**	**Mature : 55+ (n=21)**	**Mature : 65+ (n=11)**
To save money	19%	8%	19%	19%	9%
To better manage finances/budget	12%	8%	12%	14%	27%
No deposit	10%	15%	9%	10%	18%
To avoid huge monthly bills	9%	15%	13%	14%	9%
Ability to pay amount at any time	3%	0%	3%	0%	0%
To track energy usage	6%	8%	6%	10%	0%
To save energy	2%	0%	2%	0%	0%
Other	37%	46%	35%	29%	36%
Don't know/Not sure	3%	0%	3%	5%	0%

Source: Navigant Wave 1 Participant Surveys

Table 13. Wave 2 Reasons for Enrollment

Question					
What was the MAIN REASON you chose to enroll in APS Prepay? (New Respondents Only)	**Total (n=124)**	**E-3 (n=7)**	**150% (n=94)**	**Mature : 55+ (n=16)**	**Mature : 65+ (n=9)**
To save money	8%	14%	7%	0%	0%
To better manage finances/budget	27%	57%	28%	44%	44%
No deposit	21%	14%	19%	38%	33%
To avoid huge monthly bills	6%	14%	6%	0%	0%
Ability to pay amount at any time	6%	0%	5%	0%	0%
To track energy usage	4%	0%	4%	0%	0%
To save energy	0%	0%	0%	0%	0%
Other	24%	0%	26%	13%	22%
Don't know/Not sure	4%	0%	4%	6%	0%

Source: Navigant Wave 2 Participant Surveys

Sacrifice of Comfort

In comparison to their experience before the Prepay pilot, significantly fewer participants in all Wave 1 groups had to forego comforts or necessities to pay for their electricity during the Prepay pilot. As shown in Table 14, nearly one-third of total Wave 1 respondents had to forego necessities such as food; use of appliances; had to tighten their budget; or had to keep their home at uncomfortable temperatures to pay for electricity prior to the pilot. This number dropped to 17 percent after respondents enrolled in the pilot, indicating that the Prepay pilot significantly helped respondents to better manage their energy use or budgets without sacrifice. Each of the other respondent groups experienced similar reductions of numbers.

Table 14. Wave 1 Sacrifice of Comfort

Question				
Respondent Group	**n - Prior**	**Sacrificed Comfort Prior**	**n - Since**	**Sacrificed Comfort Since**
Total	86	30%	150	17%
E-3	9	56%	13	38%
150%	59	29%	104	19%
Mature: 55+	14	29%	22	23%
Mature: 65+	9	44%	11	36%

Source: Navigant Wave 1 Participant Surveys

Wave 2 respondents also showed a decrease in the necessity to forego household comforts when compared with their experience prior to pilot participation. In particular, the percentage of the mature respondents over 65 who forewent household comforts dropped by nearly 30 percent. The E-3 customers were the only group who indicated that they had to forego more household comforts since participating in the pilot, with an increase from zero to 13 percent[5] of the group. The general decrease across all groups suggests that the pilot did have some influence on customers' ability to manage their electricity budgets.

Table 15. Wave 2 Sacrifice of Comfort

Question				
Respondent Group	**n - Prior**	**Sacrificed Comfort Prior**	**n - Since**	**Sacrificed Comfort Since**
Total	68	18%	151	15%
E-3	6	0%	8	13%
150%	49	20%	95	17%
Mature: 55+	8	25%	16	13%
Mature: 65+	4	50%	9	22%

Source: Navigant Wave 2 Participant Surveys

Behavior Influence

When asked how influential the pilot was on their actions to manage their energy use, respondents offered an average score of eight on a one to ten point scale, indicating that they thought the pilot had a great deal of influence on their energy usage behavior. This influence appeared to have grown from the first wave (pre-summer) to the second (post-summer), as indicated in Table 16 and 17.

Table 16. Wave 1 Behavior Influence

Respondent Group	**n**	**Average**	**% Rated Top Box**
Total	150	8	72%
E-3	13	7	62%
150%	104	8	73%
Mature: 55+	21	8	84%
Mature: 65+	11	8	82%

Source: Navigant Wave 1 Participant Surveys

[5] E-3 respondents provided no context for this change in their survey responses and the small sample size limits the scope of any inference.

Table 17. Wave 2 Behavior Influence

Respondent Group	n	Average	% Rated Top Box
Total	144	8	79%
E-3	8	10	100%
150%	91	9	81%
Mature: 55+	15	9	87%
Mature: 65+	8	9	88%

Source: Navigant Wave 2 Participant Surveys

Drop Out Survey Results

Drop Out Overall Program Satisfaction

Drop-Out customer responses were evenly divided regarding their satisfaction with the pilot. Four of the ten Drop-Out respondents stated they were very satisfied (scores of nine or ten out of ten) with the primary reason for departing the pilot as having left the pilot because they relocated outside APS's service territory. Of the remaining six respondents, the majority gave middle to low satisfaction scores (one to six). When asked the reason they were less than satisfied, most respondents cited high costs or fees.

Reasons for Leaving the Pilot

The Drop-Out respondents were asked their main reasons for leaving the pilot. Of the ten Drop-Out respondents, half dropped out because they relocated outside APS's service territory. A full list of responses is shown in Table .

Table 18. Drop-Out Customer Reasons for Leaving Program

Question	
What was the MAIN reason you choose to stop participating in APS Prepay?	**n=10**
Relocated	5
Inconvenient to recharge my account	2
It did not help with budgeting	2
Too many disconnects	1
Can't monitor energy usage in real-time/can't see usage right away	1
Too many balance notifications	1

Multiple Responses allowed
Source: Navigant Drop-Out Surveys

D. Disconnections

This section of the report provides the descriptive statistics associated with disconnection of electric service (as a result of pilot participant's credit balance falling to zero or below), as well as disconnect timing and the related impact on on-/off-

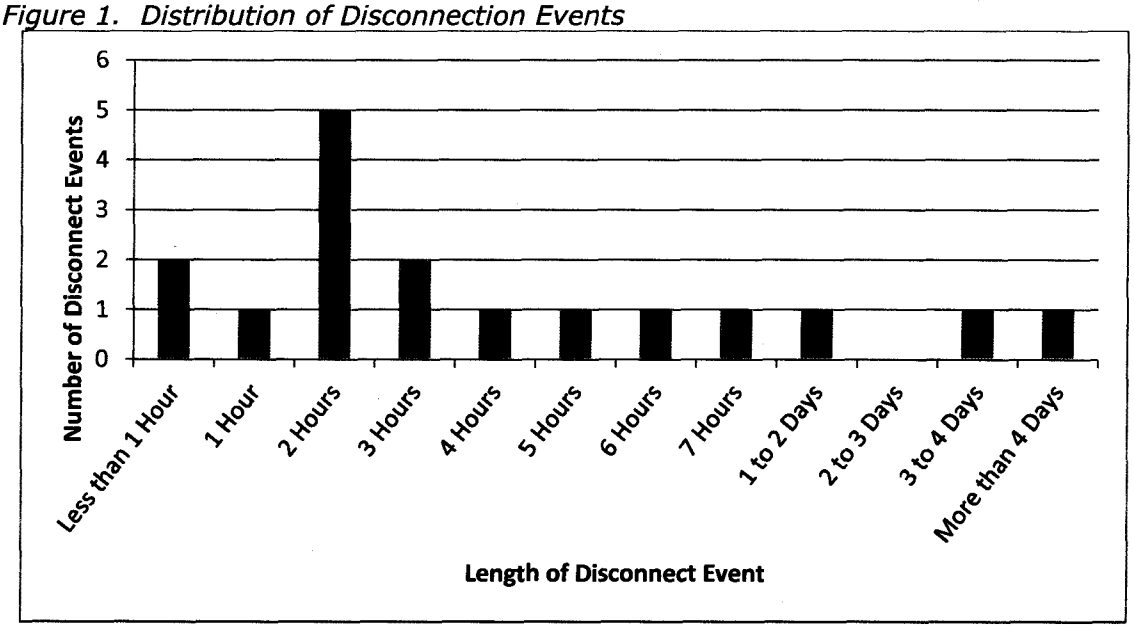
peak summer and winter load shapes. Statistics are based on the same set of data used in the analysis of savings from disconnections. Additionally, further analysis of disconnections has been conducted on the entire Prepay customer base at the recommendation of the APS Prepay Stakeholder group using queried data from the APS system.

Disconnect Statistics

APS provided disconnect and reconnect data for 357 participants enrolled in the Prepay pilot from September 2012 through October 2013. Analysis of the data showed 331 of the 357 participants had both a disconnection and reconnection event. This limited data for disconnections did not support analysis of disconnections by sub-group.

Of these 331 participants, 33 had pre-enrollment consumption data (i.e., the 33 were a subset of the 610 participants mentioned earlier in this report). Of these 33 customers, 18 were disconnected while enrolled in the Prepay pilot program, with an average enrollment duration of 53 days. These 18 customers experienced 20 disconnects while enrolled; 16 customers were disconnected once while two customers were disconnected twice. The average disconnection duration was 16.4 hours per event. For these 18 participants, the duration of disconnect events is plotted in Figure .

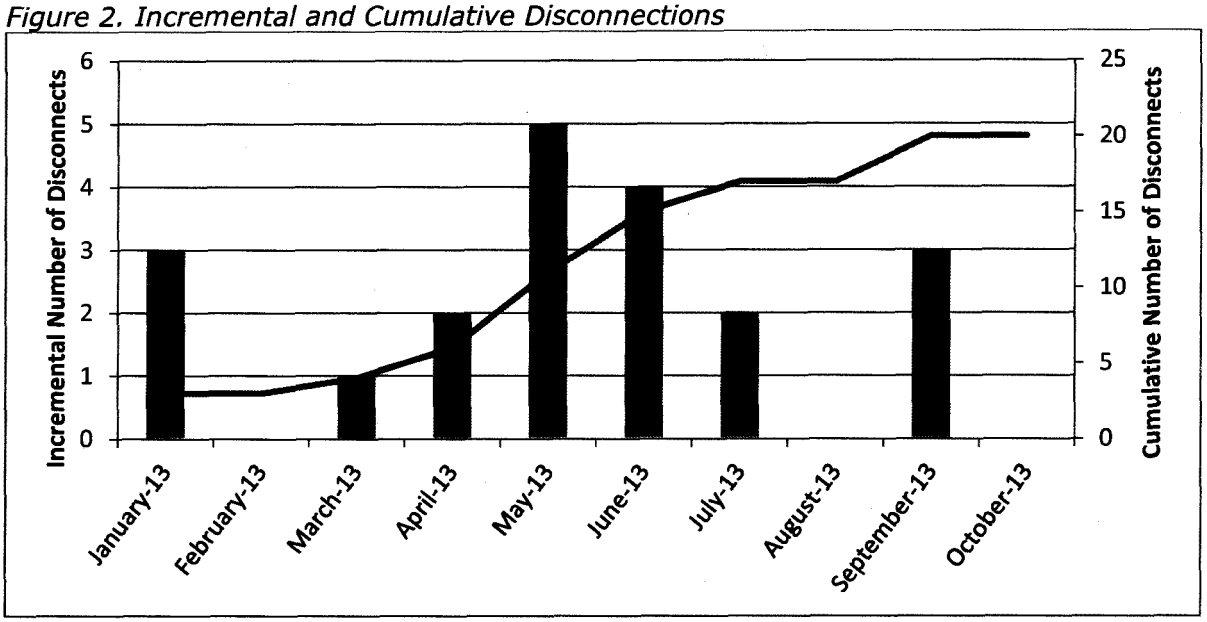
Figure 1. Distribution of Disconnection Events



Source: Navigant analysis

For these same 18 participants, Figure shows the number of disconnects per month. The bars in this figure represent disconnections by month while the line represents the cumulative number of disconnections. Disconnect events were most common in the spring and summer months of 2013. Forty percent of all disconnection events occurred between March and May 2013 and thirty percent occurred between June and July 2013.

Figure 2. Incremental and Cumulative Disconnections



Source: Navigant analysis

Disconnect Timing and Impact on On-/Off-Peak Summer and Winter Load Shapes

Navigant assessed the seasonal impact of the disconnect effect on annual energy savings by analyzing the number and duration of disconnects in 2013 occurring during the following time periods:

- Summer On-Peak: May-October, Weekdays, 12 p.m. -7 p.m.
- Summer Off-Peak: May-October, All Other Hours
- Winter On-Peak: November-April, Weekdays, 12 p.m.-7 p.m.
- Winter Off-Peak: November-April, All Other Hours

Table provides the seasonal disconnect statistics for the 18 participants who were disconnected during their enrollment period, and Table 20 provides these statistics for the larger participant set of 610—most of whom were not disconnected at all during their period of enrollment.

Table 19. Seasonal Disconnect Effect for the Disconnected Customers Analyzed (18)

	Total hours disconnected	**Average number of hours disconnected per participant**	**Percent Reduction in Consumption due to Disconnects**	**Average Reduction in Annual Energy Consumption due to Disconnect (kWh)**
Summer On-Peak	662	36.8	0.4%	69

Summer Off-Peak	1125	62.5	0.7%	118
Winter On-Peak	905	50.3	0.6%	95
Winter Off-Peak	1654	91.9	1.0%	173
Total	4346	241.4	2.8%	454

Table 20. Seasonal Disconnect Effect for All Prepay Customers Analyzed (610)

	Total hours disconnected	**Average number of hours disconnected per participant**	**Percent Reduction in Consumption due to Disconnects**	**Average Reduction in Annual Energy Consumption due to Disconnect (kWh)**
Summer On-Peak	662	1.1	0.01%	2.0
Summer Off-Peak	1125	1.8	0.02%	3.5
Winter On-Peak	905	1.5	0.02%	2.8
Winter Off-Peak	1654	2.7	0.03%	5.1
Total	4346	7.1	0.08%	13.4

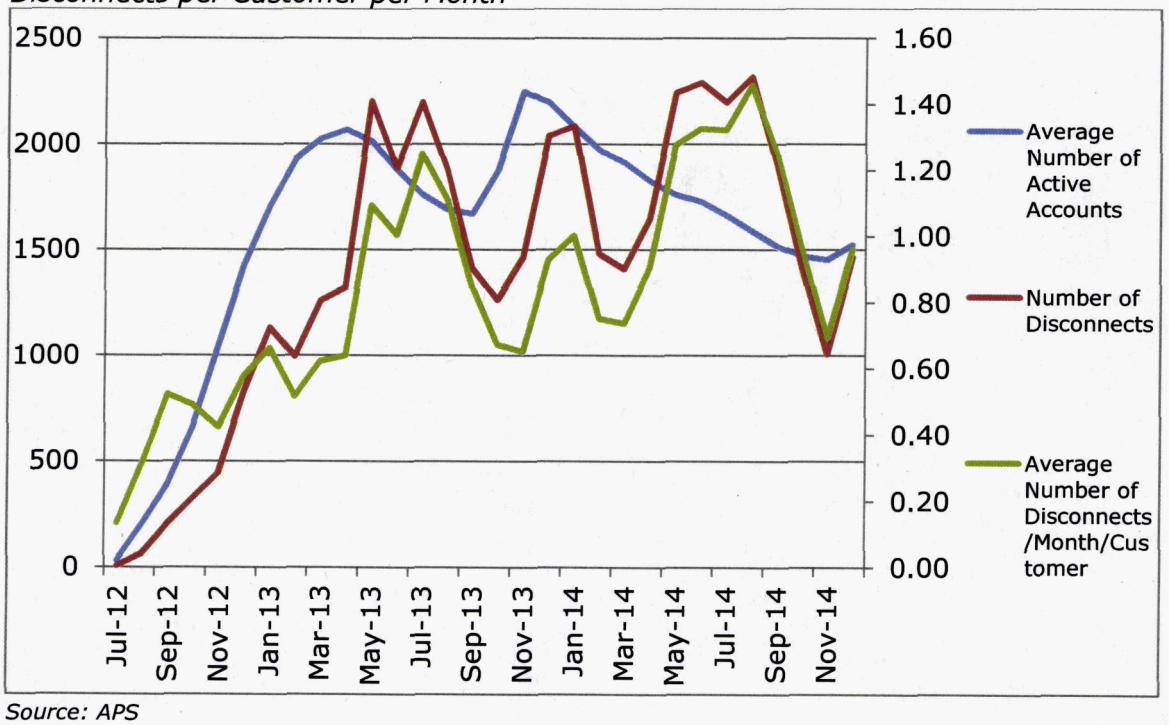
Source: Navigant analysis

Additional Pilot Disconnect Data

In addition to the data Navigant analyzed that included rigorous pre and post data from a smaller population, additional information about the disconnections for the entire Prepay customer base is indicated below.

Using the raw disconnect order history and the average numbers of customers in the Prepay pilot per month during the length of the pilot, Figure 3 highlights the trends of the enrollment levels, the number of disconnects and the average number of disconnects per customer per month. The figure shows that the highest enrollment count during the pilot was in November 2013. It also shows that on average, there are 0.8 disconnections per customer per month. The highest ratio was 1.46 disconnections per customer per month in August 2014. These numbers include customers that have disconnected due to debit balances, customers who choose to be disconnected and customers that have left the APS service territory and have let their credit balances run out instead of terminating service by contacting APS.

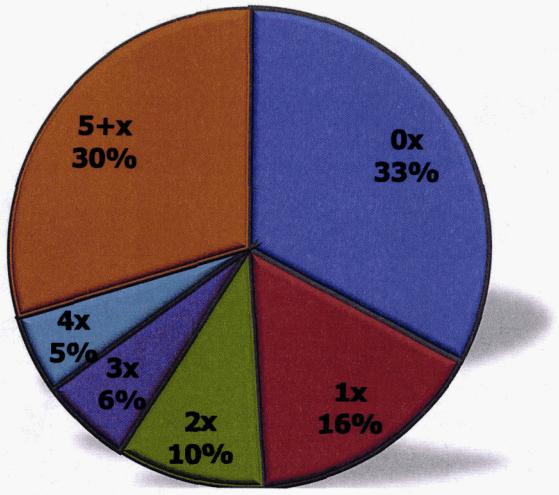
Figure 3. Active Accounts, Number of Disconnects and Average Number of Disconnects per Customer per Month



Source: APS

Figure 4 provides additional detail on the disconnect picture by indicating the percentage of customers who have disconnected by number of times.

Figure 4. Percentage of Customers Who Have Disconnected by Number of Times



Source: APS

Thirty three percent (33%) of the customers have never disconnected and an additional 16% disconnected only once. The other half of the customers has disconnected two plus times.

When looking at these disconnections and looking deeper into disconnection duration, Prepay customers were disconnected 7.5 hours on average. This takes into account all disconnections and averaged the time disconnected for all Prepay customers for all disconnections. This is a much shorter disconnection period than standard billed customers. This is likely due to the fact that Prepay customers only need to establish a credit balance and do not need to pay disconnect, reconnect and late fees to re-establish service.

E. Estimated Reads

APS has implemented the estimated read process outlined in Service Schedule 8: Bill Estimation. This includes:

- Estimating missing data using the most recent day for which adequate information is available for the site. Missing weekday information is estimated with the most recent available weekday information. Missing weekend and Holiday information is estimated with the most recent available weekend day information.
- If historic daily meter information is not available for the site, the estimates will be based upon the class average data and the on-peak factors if applicable.
- If a customer's usage is estimated for 3 days, APS works to obtain the actual meter information and determine the reason for the estimated read. APS also calls the customer and informs them about the estimated reads.
- APS does not disconnect customers who have a negative balance caused by an estimated read that has not been trued up with an actual read.

Per Decision No. 73223 requiring a report on Prepay bill estimation, APS analyzed one year of data (2013). There were 647,109 total reads and of those, 6,857 (1.06%) were estimated. Of the 6,857 estimated reads, only 418 (0.06%) were estimated for three days or more. Data in 2014 suggests that the percentage of estimated reads has dropped to 0.57% and of those 0.10% were estimated for three days or more.

Additionally, of the reads estimated in 2013, APS underestimated the estimated read 86.4% of the time when compared to the actual read.

VI. Plan for the Future

Based on the results presented in this report, including the proof of verified energy efficiency savings from Prepay, APS plans to continue this cost effective program. At this time, APS is proposing to continue at the 2,000 customer level and remove the program's pilot status while claiming ongoing verified savings toward the Energy Efficiency Standard. While current participants are highly satisfied with the program, APS believes that refinements can be made to enhance the operations of the program before it is expanded. Within the 2,000 participant limit, APS proposes that customers throughout the APS service territory could be eligible to participate rather than limiting the program to Phoenix metro area customers only. APS will continue to monitor and report on the effectiveness of the Prepay program through the DSM measurement and evaluation process and will consider expansion of the program at a later date in a future DSM portfolio filing.

VII. Conclusion

The results from this program evaluation indicate that the average Prepay customer saves 7.5% annually or a deemed savings value of 1,235 kWh/year when compared to a statistically similar control group and after removing the impact from disconnects and other DSM program participation. The average annual disconnect effect and the DSM program participation effect were both found to be very small relative to the conservation effect. The impact to different customer segments (life stage and income level) was also analyzed and was found to be statistically no different than the overall population based on the available sample size for this analysis.

The process survey results indicated that customer satisfaction was high, that customers sacrificed comfort less in Prepay than standard billing and there are areas that have been identified for improvement before expanding the Program.

Based on the impact results and projected costs for the program moving forward, APS Prepay is cost effective with a benefit/cost ratio at 1.03 and a projected annual budget of $83,500 for 2,000 participating customers.

APS recommends the Residential Prepaid Energy Conservation Pilot be moved from pilot to a fully implemented standard DSM program for approximately 2,000 customers throughout the APS service territory in 2015.